

so much other trouble that I believe it cannot be too frequently criticized.

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DOCTOR SEAVER (closing)—The above discussions emphasize the present trend toward conservative pelvic surgery.

For some strange reason, woman was so planned that for a certain period of her life menstruation is a normal function. It does not seem to be within the province of mere man to put an end to that function unless absolutely necessary. One dissatisfied woman should be sufficient reason for conservative thought. One hundred and sixty-five, or 63 per cent, is a definite indication for conservative practice. The incidence of the normally menstruating woman will be higher as more of her own sex are admitted to the practice of medicine.

The question of routine appendectomy was mentioned by the three discussants. Here, too, conservatism is in evidence, so that in the future it may be that woman will be permitted to retain her normal appendix. However, when that organ is removed during the course of a pelvic operation the method of procedure seems most important. Some few clinics which advocate routine appendectomy still adhere to the old rule of removing the appendix first, with the idea of preventing contamination from the pelvis. This seems indicated only in cases where the pelvis is the seat of infected pus. No matter who the surgeon is there is always an increased risk to the patient from the time consumed in an appendectomy, and that risk should be taken after the major pathology is cared for and not before.

ANESTHESIA—SOME OF ITS POSTOPERATIVE PULMONARY COMPLICATIONS*

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THERE can be no doubt that postoperative pulmonary complications are surprisingly frequent, and often severe. Statistics show that some pulmonary complication develops in one patient in every fifty who is operated upon, regardless of the anesthetic used, and that one patient in every three hundred operated upon, dies as the result of such a complication. To discuss all phases of this subject at one time is too much of an undertaking. However, certain definite types of postoperative pulmonary complications may be recognized clinically, and it is my purpose to present some of these types, to discuss their possible etiology, and to indicate certain measures which might lessen their frequency. Fat embolism and the effect of anesthesia upon pulmonary tuberculosis will not be considered.

THE EARLY INFLAMMATORY COMPLICATION

The complication which comes soon after the operation is probably the most common type of postoperative pulmonary complication. It occurs within twenty-four to forty-eight hours after operation, is manifested by a fever which may range from 101 to 105 degrees F., usually unaccompanied by an initial chill. The breathing is rapid, shallow, and the movements of the upper thorax are often exaggerated. There is little or no pain, the pulse is rapid and weak, and the cough is at first unproductive. Râles or signs of consolidation in the lungs are sel-

dom found at the onset of the early complication. During the course of the disease, the cough produces purulent phlegm, loud bronchial râles are heard throughout both lungs, and small scattered areas of bronchopneumonia may appear, usually at one or both bases. The fever falls by lysis, and the patient is usually well in nine or ten days.

Case I illustrates this type of early complication.

CASE I—Mrs. F. S. Age, 38 years. Diagnosis: cholecystitis and cholelithiasis with stone in common duct.

October 2, 1926—Operation: cholecystectomy and drainage of common duct. Anesthesia: nitrous oxide and oxygen, novocain infiltration of the abdominal wall. During the operation the patient's breathing was labored and "grunting" in character, and muscular relaxation was poor. At the close of the operation the patient vomited several ounces of fluid characteristic of an acutely dilated stomach. She coughed several times and became cyanotic, which required the administration of oxygen for several minutes.

After leaving the operating room, the patient's respiratory rate rose to 30-40 per minute, pulse to 120-30, but the temperature remained below 100 degrees F.

October 3, 1926—At 8:45 a. m. the day after operation, the patient coughed up about one ounce of fluid similar to that which she had vomited in the operating room. The temperature had risen to 105.2 degrees F., pulse to 140, and respirations to 32-50. Breathing was shallow with marked movements of the upper thorax. There was no pain, but a moderate, unproductive cough. Examination of the chest showed no râles or signs of consolidation.

The patient then began coughing up mucopurulent sputum and within two days the respirations were free, at the rate of 30 per minute. Loud, harsh, sonorous râles were heard in both lungs the second day. On the fourth day a small area of bronchial breathing and dullness appeared in the posterior part of the lower left lobe. The fever fell gradually, the cough and area of consolidation disappeared, and on the eighth day the temperature was normal and the lungs were clear. The healing of the abdominal wound was not disturbed, and further convalescence was normal. Unfortunately no roentgenograms could be made of this patient, but Fig. 1 shows the variations in temperature during the first ten days.

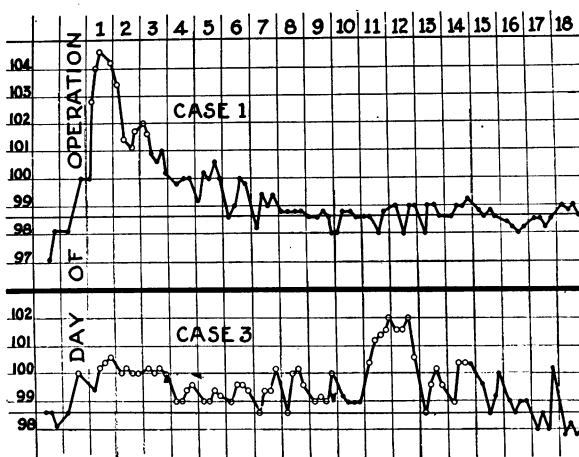


Fig. 1—Contrasting the temperature charts in a case of early inflammatory complication (Case I) and a case of late inflammatory complication (Case III).

Some patients do not have so severe a condition as that shown by Case I, and except for a mild bronchitis no pulmonary disease can be demonstrated. Frequently such mild complications are not recognized and the surgeon blames the operative wound for the patient's fever. Other patients are unable to withstand the severity of the disease, and death occurs at the onset the first or second day after the

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operation. The early pulmonary complication is not usually followed by empyema, unresolved bronchopneumonia or lung abscess, although such complications do occur. Usually a general anesthetic has been given, with considerable difficulty in its administration. The breathing during the operation is not free and easy, as it should be, and the anesthetist's report often includes such statements as, "relaxation poor," "cough troublesome," "cyanosis moderate or extreme," "vomiting," etc.

Case II illustrates an early pulmonary complication followed by an area of unresolved bronchopneumonia in which a pulmonary abscess developed. It is interesting that this patient had suffered with chronic bronchitis and mild attacks of asthma for several years.

CASE II—Mr. J. L. Age, 45 years. Diagnosis: cholecystitis and appendicitis.

February 23, 1926—Operation: cholecystectomy and appendectomy. Anesthesia: ether with nitrous oxide induction. The anesthetist's report states that the patient's breathing was difficult, labored, and diaphragmatic in type. There was moderate cyanosis, and muscular relaxation was poor.

February 24, 1926—The day after operation the patient complained of difficulty in breathing, but not of pain. His temperature rose to 105 degrees F.; pulse, 120-132; respirations, 26-32. Examination showed many coarse râles in both lungs and a small area of distant breath sounds at the right base. A roentgenographic examination showed some hazy patches of consolidation at the middle and lower portions of the right lung field. This was interpreted as an area of bronchopneumonia.

The next day the patient had an unproductive cough and fever of 103 degrees F., with no change in the pulmonary signs. The fever continued from 100 degrees F. to 101.6 degrees F., for eighteen days, when the temperature rose to 103 degrees F., and the area of consolidation at the right base was found to be increased. On the twenty-second day the roentgenographic examination showed an air-filled cavity in the axilla, under the sixth rib. The cavity measured 5 cm., and was half-full of fluid. (See Fig. II.)

The lung abscess was drained by rib resection. Five weeks later the patient was dismissed from the hospital.

Comparing Cases I and II, the pulmonary complication began in both cases within twenty-four hours after operation with a very high fever and comparatively few signs in the lungs. Case I recovered in nine days, but in Case II a lung abscess slowly developed. The complication in this instance was probably dependent upon the pre-existing pulmonary disease.

THE LATE INFLAMMATORY COMPLICATION

Another form of pulmonary complication is that which occurs several days after the operation, preceded by an interval of uncomplicated convalescence. The most frequent time of occurrence is on the eighth to the twelfth day, although some cases of this type occur as soon as the second day or as late as the third week. The onset is sudden, the patient frequently dating it to a certain hour. Pain throughout one side of the chest is the first complaint, made worse by deep breathing or body movements; consequently breathing is shallow and rapid. Cough is painful, and about one-third of these patients have blood-tinged sputum. A moderate fever, 102-103 degrees F., usually of the septic type, develops. Examination of the chest soon after the onset of symptoms frequently shows a friction rub, diminished breath sounds, and dullness to percussion over a restricted area. This area of consolidation may be in any part of the lung, upper, middle, or lower, but it is most frequently seen in a lower lobe. In the course of the disease, pain may remain a prominent feature, the fever falls gradually, and the signs of consolidation slowly disappear.

The following case illustrates this late inflammatory complication:

CASE III—Mr. P. S. Age, 28 years. Diagnosis: appendicitis, chronic. Operation: August 13, 1925. Appendectomy and exploration of abdomen. Anesthesia: ether with nitrous oxide induction.

The recovery was uneventful for ten days, temperature never above 100 degrees F. after the first day, and

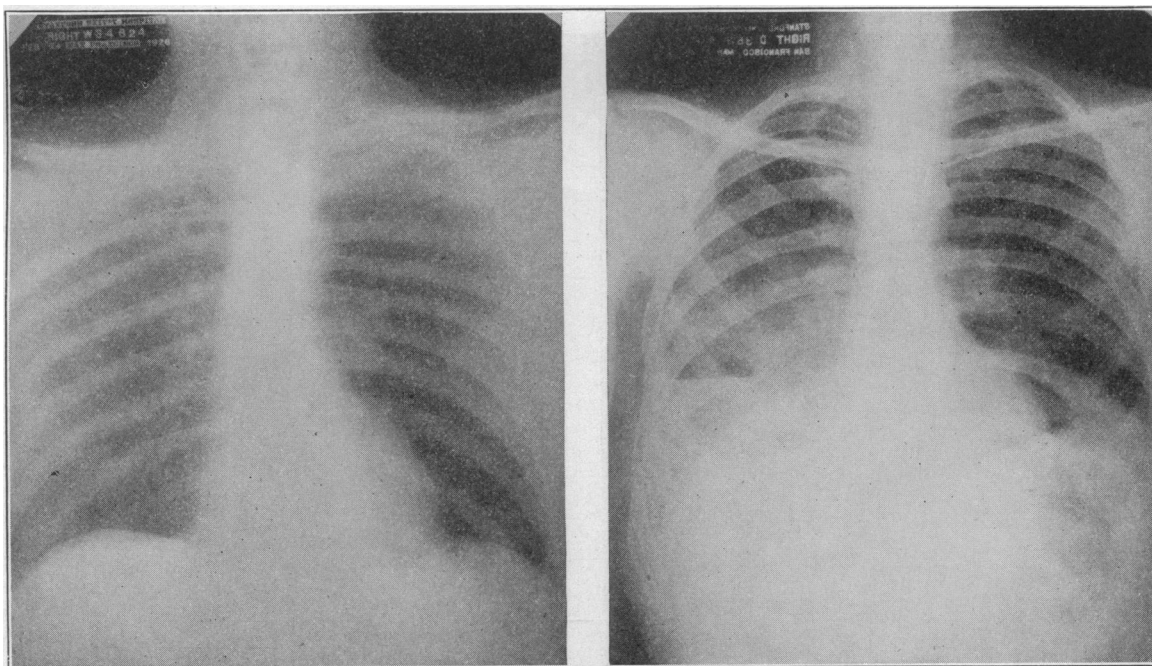


Fig. II—Case II—Early Inflammatory Complication. The film on the left was made the day after operation, when the pulmonary symptoms appeared. Note the moderate density in the right lower lobe. The film on the right was made twenty days later. A large abscess cavity half-full of fluid is seen in the right lower lobe.

the patient had no complaints. However, at 5:30 a. m. of the eleventh day after operation, the patient had a sudden attack of severe sharp pain all over the left side of his chest, radiating to the left shoulder, made worse by breathing or body movements, but he did not cough. The temperature rose to 102.2 degrees F., pulse to 100, and the respirations to 22 per minute. The leukocytes numbered 16,000 with 86 per cent polymorphonuclears. Examination of the chest showed a limited excursion of both bases with bronchial breathing, dullness and râles at the angle of the left scapula, and a friction rub heard in this area. The following day the roentgenologist reported, "The costodiaphragmatic angle is denser on the left than on the right. There is pleural thickening at the left base, with a small amount of fluid posteriorly."

The daily fever, pain on deep inspiration, and signs of consolidation disappeared slowly, and the patient was not dismissed from the hospital until twenty-five days after the onset of his pulmonary complication.

The temperature charts of Case I illustrating the early inflammatory complication, and Case III illustrating the late inflammatory complication, are seen in Fig. I.

The late pulmonary complication may follow operations under local as well as general anesthesia. It is frequently accompanied or followed by empyema, or lung abscess, is frequent after abdominal or pelvic operations and operations on the throat, mouth, or neck. During the interval between the operation and the onset of the attack there frequently is a slight fever, seldom more than one degree. That the severity of the attacks vary is to be expected, and the dreadful disaster of massive pulmonary embolus with sudden death is only too well known to all clinicians. The other extreme, a sudden attack of pleurisy lasting twenty-four to forty-eight hours, with little or no fever, is a fairly common occurrence.

Case IV illustrates a late complication which resulted in empyema and lung abscess.

CASE IV—Mr. G. A. Age, 35 years. Diagnosis: tonsillitis, chronic.

February 10, 1921—Operation: tonsillectomy and ad-

enoidectomy. Anesthesia: ether with nitrous oxide induction.

The convalescence was uneventful for four days, the temperature never above 100 degrees F. On the fifth day, there developed pain throughout the right chest, fever, and cough with bloody sputum. Examination of the chest showed an area of dullness at the right base, and diminished breath sounds and bronchial breathing in the same area. The condition grew worse, a pleuritic rub developed, and on February 21, the sixth day after the onset of pain, the roentgenologist reported an area of density, somewhat triangular in shape, at the right base. The fever and leukocytosis increased. An empyema and a gangrenous abscess of the lung developed, and the patient was operated upon four times before he was cured.

Fig. III shows the pulmonary condition six days and forty days after the onset of the pulmonary complication.

POSTOPERATIVE MASSIVE COLLAPSE OF THE LUNG

A third type of pulmonary complication, called "postoperative massive collapse," is considered separately because it does not seem to be inflammatory. It presents characteristic signs and symptoms. The attack usually comes within a few days after operation. There is respiratory distress, with short rapid breathing, pain in one side of the chest, moderate fever, rapid weak pulse, and a cough which is at first dry and unproductive. Examination of the chest shows almost complete lack of motion on the affected side, and retraction of the fossae and intercostal spaces is seen in many cases. The heart is greatly displaced toward the affected side, the affected lung is dull to percussion, and the breath sounds and fremitus are markedly diminished or absent. This condition is seldom fatal, and a majority of cases return very quickly to nearly normal. This disappearance of signs and symptoms is often preceded by the patient's coughing up a considerable quantity of thick mucus, and the improvement frequently takes place in the course of a few min-

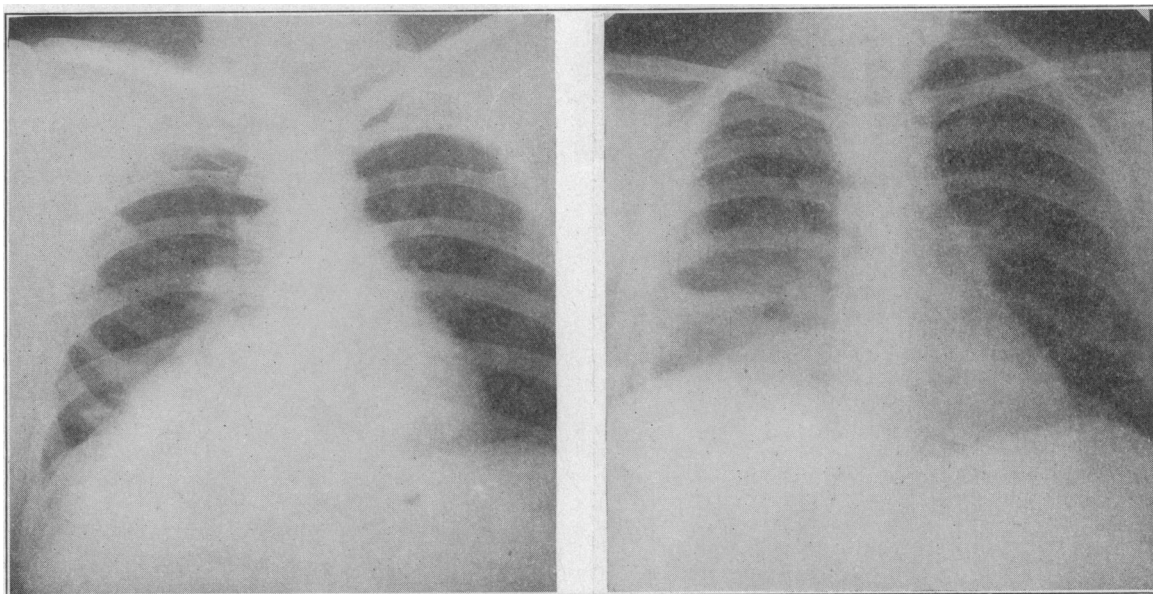


Fig. III—Case IV—Late Inflammatory Complication. Pulmonary symptoms appeared five days after the operation. The film on the left was made six days later (eleven days after the operation). Note the consolidation in the mesial portion of the right lower lobe. The film on the right was made forty days after the onset of pulmonary symptoms. Heavy pleural thickening persists after drainage of empyema. A gangrenous abscess has developed in the right lower lobe.

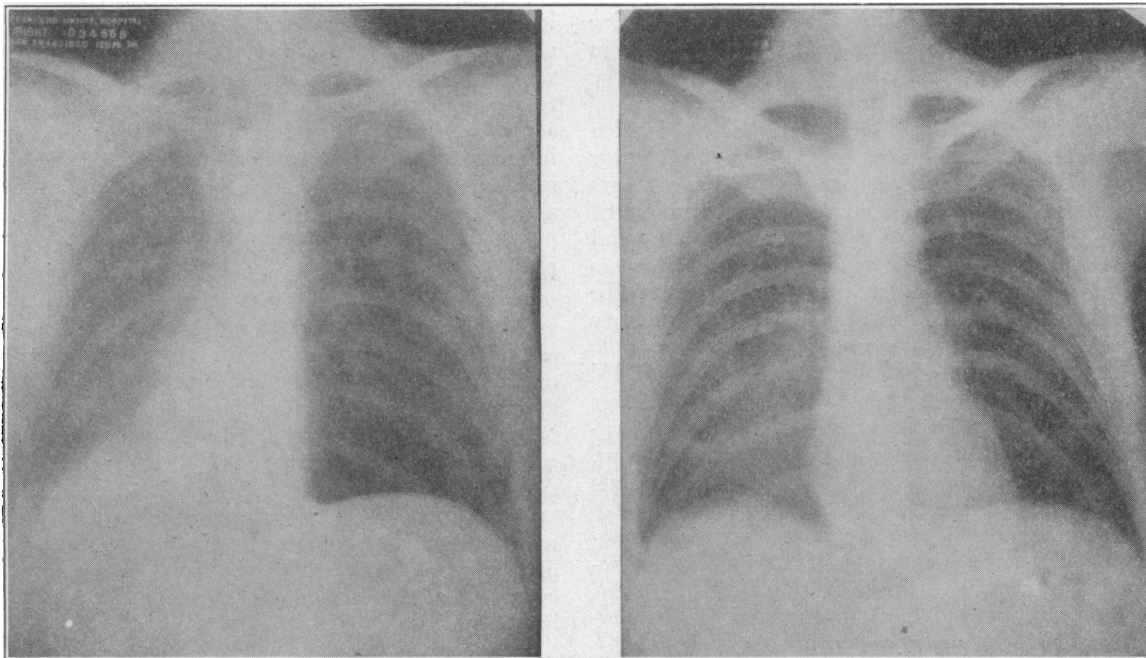


Fig. IV—Case V—Postoperative Massive Collapse. The film on the left was made the day after operation, when the pulmonary symptoms appeared. Note the small volume and relatively airless condition of the right lung, the pulling in of the ribs on the right, the marked displacement of the heart and mediastinum to the right and the upward displacement of the right side of the diaphragm.

The film on the right was made twenty-four hours later. The right lung has re-expanded spontaneously, leaving, however, a little consolidation in the inner portion of the lower lobe.

utes. In other patients the improvement is gradual and the signs disappear slowly.

Case V illustrates "Postoperative Massive Collapse" in a patient recovering spontaneously.

CASE V—Mr. I. L. Age, 38 years. Diagnosis: carcinoma of stomach. Operation: February 18, 1926. Pylorectomy and gastrojejunostomy. Anesthesia: ether with nitrous oxide induction.

At 3 the next morning, February 19, 1926, the patient complained of shortness of breath, irritation in his throat, and inability to clear his throat by coughing. By 9 o'clock his breathing was labored, the accessory muscles of respiration were being used, and there was moderate cyanosis. The respirations were 32 per minute, the pulse 140, and the temperature 102.4 degrees F. Examination of the chest showed the movements of the right side markedly limited, and the clavicular fossae retracted. The cardiac movements were visible on the right, but the apex beat could not be seen or felt. The right lung was dull to percussion, and the breath sounds and fremitus were greatly diminished. Roentgenograms taken that morning were reported: "The whole right lung field is rather grey. The heart and mediastinum are displaced far to the right. The left lung field is not remarkable." The patient's condition remained unchanged throughout that day, February 19, 1926. During that night, however, he coughed up a considerable quantity of thick mucus, and was relieved almost immediately of his respiratory distress. Examination the next morning, February 20, 1926, showed both sides of the chest moving freely and that the retraction of the right clavicular fossae had disappeared. His color was good, both lung fields were resonant, the respiratory rate was 22, and the temperature was 100 degrees F. The second roentgenogram, made just twenty-four hours after the first one, showed the right lung field expanded again to nearly normal volume, and the mediastinum returned to the midline. The lower mesial portion of the right lung field showed a fuzzy, finely mottled density suggesting consolidation. This patient's condition was good from that time on, and except for a mild cough for three days he had no complaints and there were no signs of pulmonary disease.

Fig. IV shows the lung during collapse, and

twenty-four hours later, when it is almost completely inflated again.

COMMENT

A study of the literature shows that the causes of postoperative pulmonary complications are not agreed upon, as many different opinions have been expressed. Foremost among these are direct pulmonary infection or irritation, pulmonary embolus and infarction, and lung deflation or collapse.

The early inflammatory complications, frequently called "ether pneumonia," "postoperative pneumonitis" or "surgical bronchopneumonia," seem to have the widest variety of causes ascribed to them. The anesthetist is most frequently blamed for this type. Certain it is that most of these patients have had a general anesthetic, which was unsatisfactory in many cases, even though skilfully given. The fact that chilling during or following an operation often plays a part, cannot be overlooked. That pre-existing pulmonary lesions, either acute or chronic, are often made worse by a general anesthetic is also recognized. I believe that aspiration during general anesthesia has received a little more than its share of the blame. The experimental work of Lemon,¹ and the observations of many anesthetists during oral or pharyngeal operations, shows that practically every patient under general anesthesia aspirates the secretions of the mouth and throat, at least into the trachea, if not into the bronchi. Not all of these patients develop a bronchitis or pneumonia, however, so aspiration of the oral secretions seems insufficient as a cause. Open foci of infection in the mouth at the time of operation is also considered a possible cause of lung infection, by some authors. The aspiration of stomach content, vomited while the patient is still unconscious, surely influences, if

it is not entirely responsible for some postoperative pulmonary disturbances. This is particularly true in patients suffering from an acute dilatation of the stomach, and in cases of intestinal obstruction.

Pasteur² and Briscoe³ believe that collapse of a part of one or both lower lobes is responsible for most of these early complications. Briscoe shows that deflation is a consequence of the prolonged supine position in certain types of individuals, and occurs during sleep as well as anesthesia. Others believe that operations which interfere with the movements of the diaphragm, or cause its temporary fixation, are responsible for the deflated lung.

Whipple⁴ and Cleveland⁵ have found Type IV pneumococcus in the sputum, both before and after operation, in a large majority of patients developing an early postoperative pulmonary complication. They do not find the pneumococcus in those patients who develop a late complication.

Pneumonia is very difficult to produce experimentally by the bronchial route. Some success is reported when massive doses of the infecting agent are used. Blake and Cecil⁶ report successful production of lobar pneumonia, in monkeys, with very small doses of pneumococci, given intratracheally. Lobar pneumonia is not a common occurrence following operation, however, and here on the Pacific Coast it is extremely rare.

The process of venous thrombosis and embolism is well known to all physicians, and most of us are acquainted with sudden death from a pulmonary embolus. There seems to be little doubt that this same process may be responsible for many of the less dangerous pulmonary complications. The term "pulmonary infarction" is commonly given to the late complications. Fetterolf and Fox⁷ have shown that extensive thrombosis of the veins in the neck regularly follows tonsillectomy. Cutler and Hunt⁸ report a series of these late complications, and point out that such complications are most frequent after operations on some part of the body that is freely movable, e. g., abdomen, throat, jaw, groin, and seldom occur following a craniotomy, for example, where the tissues are anatomically splinted. An embolus may be dislodged during the course of an operation, or as late as the third week following operation, but the most frequent time is from the eighth to the twelfth day.

Holman, Chandler, and Cooley⁹ have recently reported a series of lung abscesses, both pyogenic and tuberculous, produced in dogs, after the method first described by Holman.¹⁰ They produced the abscesses by introducing an infected embolus into the circulation through the jugular vein. The course of the pneumonic disease produced in these animals receiving emboli infected with pyogenic organisms is so similar to the late type of postoperative pulmonary complication that an analysis of this experimental work is justified.

Quoting from the experimental report: "The effect of introducing a pyogenic embolus into the venous circulation differs widely in different animals. There may occur only a local consolidation and pneumonitis about the embolus, with early and complete recovery and no permanent pulmonary damage. Hemorrhagic infarction may occur fol-

lowed either by recovery, or by formation of an abscess and then recovery. In other instances abscess formation is followed by death, probably due to a complicating septicemia. There may occur also a massive hemorrhagic consolidation brought on by interference with the circulation of the affected lobe, incident to an extensive thrombosis of the pulmonary artery proximal and distal to the embolus."

In those experimentally produced pulmonary infarcts and abscesses the consolidation was present soon after the embolus was introduced. The fever and leukocytosis gradually increased, and lung abscess developed about six days after the introduction of the embolus. The embolus, introduced with the animal in the supine position, lodged in the left lower lobe fourteen times, right lower lobe eleven times, left upper lobe twice, right upper lobe once, and right middle lobe once.

Thus the clinical features of the results of infected pulmonary embolus in the experimental animals parallel very closely the clinical features of the late postoperative pulmonary complication that I have reported.

Several writers have given several different causes for postoperative massive collapse. Most cases reported have followed general anesthesia, but we know that massive collapse of the lung may follow gun-shot wounds outside of the chest, and it sometimes follows diphtheria. In neither of these latter conditions have the patients been anesthetized. Such conditions as reflex spasm of the bronchioles, fixation of the diaphragm with retraction of the chest wall, and plugging of the bronchi by thick mucus have been given as causes of collapse. Briscoe³ says: "Postoperative massive collapse is produced by the onset of inflammation, affecting the pleura over the diaphragm, or the muscles of the crus situated behind the diaphragm, in an individual in whom the lower lobes are already deflated." On the other hand, Tucker¹¹ demonstrated that bronchial obstruction is caused by tenacious mucus, in cases of massive collapse, and that function is quickly restored to the lung by the bronchoscopic removal of this obstruction.

I do not know that anyone has successfully produced massive collapse in animals.

I do not believe there is any single cause which will account for all the cases of the early inflammatory complications. I think that most cases are caused by a combination of several of the previously mentioned factors. Some of these factors may occasionally act as the sole factor. I believe the majority of the late type are caused by emboli, the severity of the result depending upon the size of the embolus, whether or not it is an infected embolus, and upon the condition of the lung in which it lodges. I do not venture an opinion as to the cause of massive collapse, but the work of Tucker in removing mucus plugs from the bronchi in such cases is very convincing.

How can we prevent these complications? I do not believe that we can ever prevent all of them. Nevertheless there are a good many things we can do which might lessen their frequency. If possible the patient's stomach should be empty before a general anesthetic is given. In cases of gastric reten-

tion or bowel obstruction, gastric lavage should be performed before the patient is asleep, not during the course of the anesthetic.

Pre-existing pulmonary lesions should be carefully searched for, and a patient with any infection of the respiratory tract should not be given a general anesthetic if it can be avoided. The anesthetic should be given with such skill as to maintain even muscular relaxation, preventing the return of the pharyngeal reflexes during the operation, and preventing cyanosis, whenever this is possible. The position of the patient during operation favors a stormy postoperative convalescence in many instances. The use of pillows, sand-bags, and other apparatus is frequently demanded by the surgeon, that he may secure a better exposure of his operative field. The use of such apparatus should be discouraged whenever it will interfere with the movements of the diaphragm or the aeration of the inferior lobes of the lungs. To have the patient in a sitting position during general anesthesia is an almost criminal procedure. The position of choice is a slight Trendelenburg's position. Suction should be used to prevent aspiration during all operations on the mouth and throat. The patient should not be chilled or exposed to cold air during or for several hours after an operation.

The surgeon should not begin his operation before the patient is properly anesthetized. He should be gentle in his manipulations and in handling the tissue. All measures to prevent wound infection should be vigorously enforced to limit the chances of venous thrombosis. Intelligent postoperative care and observation may prevent the dislodging of a thrombus.

Such procedures as I have suggested are not new, but are frequently overlooked or carelessly observed, and they require cooperation between the anesthetist and the surgeon. The more the surgeon knows about the art of giving an anesthetic, and the anesthetist knows about the patient's disease and general physical condition, the more effective will be this cooperation.

CONCLUSIONS

1. Postoperative pulmonary complications are frequent, and they may be severe.
2. Such complications occur after operations under local anesthesia as well as under general anesthesia.
3. There is no single cause of all postoperative pulmonary complications, but the possible causes have been reviewed.
4. The prevention of all postoperative pulmonary complications seems impossible, but measures which might lessen their frequency have been suggested.

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THE SUPERVISION OF DIAGNOSTIC LABORATORIES

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INCREASING attention is being given in different states to the need of some sort of supervision of clinical and public health laboratories. Realization of this need was first appreciated or at least first manifested by official public health agencies. The health department of New York State was the first to inaugurate a system of laboratory control, and California was, I believe, the second in line, with the action of the State Board of Health in 1923 in authorizing the Hygienic Laboratory to initiate a system of voluntary certification.

The need for protection of the people and their physicians and health departments against a low standard of service in this important field is evident to every competent laboratorian and to every physician who is himself sufficiently in touch with laboratory methods to recognize ignorance and charlatanism when it appears in the guise of diagnostic laboratory service; for there are charlatans in diagnostic laboratories as there are in the general field of medicine.

METHODS OF SUPERVISION

The only difference of opinion likely to arise concerning this subject is in the matter of how supervision should be brought about; whether by legislative enactment or by exercise of general powers by some official body having such general powers as the Board of Health, or by a system of voluntary cooperation on the part of the laboratories with some self-appointed central source of control such as the Board of Health, other state commission, or the laboratories themselves. Another alternative would be to leave it to the slow process of natural evolution through growing understanding on the part of physicians and an awakening consciousness of responsibility on the part of the laboratorians. If it were the regulation of the practice of medicine that was being considered it goes without saying that the last method would be generally accepted by nobody but the charlatans themselves. Why physicians should not apply to their laboratory workers the same reasoning regarding the necessity of adequate education and experience that they apply to themselves, is something of a puzzle. It is doubtless to be explained by lack of thought and attention that is given this specialty of medicine by the profession in general. Whatever the explanation, it is a fact that less concern is shown by the average individual physician in routing his specimens to a laboratory and by the average group or hospital in employing a laboratorian than to almost any other type of service they make use of. The influences that determine the physicians' choice are, without question, generally the same that influence patients in selecting their physicians. For some the sign on the door is sufficient or the statement of the applicant for a job that he or she is a bacteriologist, or that he or she is fresh from the laboratory of some "hospital." True, the former job may have been that of dish washer, but this is ordinarily not gone into. Others may be more cautious; they may require the recommendation of someone else no more qualified than